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ABSTRACT

A study explored an application of rauding theory to the developmental components that contribute to elementary-age children's reading comprehension. The relationships among cognitive power, auditory accuracy level, pronunciation (word recognition) level, rauding (comprehension) accuracy level, rauding rate (reading rate) level, and rauding efficiency (reading comprehension rate) level were examined using structural equation modeling to confirm the model reported by R.P. Carver. The Kaufman Assessment Battery for Children (KABC) and the Kaufman Test of Educational Achievement (KTEA) subtests were used to operationalize the various constructs and the national normative samples were utilized for data analyses at grades 1-2, 3-4, and 5-6. Because rate measures were only available on the KTEA and a measure of listening comprehension only on the KABC, the Carver model was assessed at each grade level in 2 parts, with overlapping paths allowing cross-validation of some coefficients. For grades 1-2, the fit indices were above .95, indicating good model fit. One additional path was supported, from pronunciation level to rauding efficiency level. The fit indices for grades 3-4 were above .95, supporting the modified Carver model. Grades 5-6 analyses produced fit indices above .90, again supporting the modified Carver model. (Contains 32 references and 4 figures of data.) (Author/RS)

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Exploration of the Components of Children's Reading Comprehension Using Rauding Theory

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Abstract

The purpose of the present study was to explore an application of rauding theory (Carver, 1992; 1993; 1995) to the developmental components that contribute to elementary-age children's reading comprehension. The relationships among cognitive power (C_p), auditory accuracy level ($AudA_L$), pronunciation (word recognition) level (P_L), rauding (comprehension) accuracy level (A_L), rauding rate(reading rate) level (R_L), and rauding efficiency (reading comprehension rate) level (E_L) were examined using structural equation modeling to confirm the model reported by Carver. The Kaufman Assessment Battery for Children (KABC) and the Kaufman Test of Educational Achievement (KTEA) subtests were used to operationalize the various constructs and the national normative samples were utilized for data analyses at grades 1-2, 3-4, and 5-6. Because rate measures were only available on the KTEA and a measure of listening comprehension ($AudA_L$) only on the KABC, the Carver model was assessed at each grade in two parts, with overlapping paths allowing cross-validation of some coefficients.

For grades 1-2 the fit indices were above .95, indicating good model fit. One additional path was supported, from P_L to E_L. The fit indices for grades 3-4 were above .95, supporting the modified Carver model. Grades 5-6 analyses produced fit indices above .90, again supporting the modified Carver model.

Exploration of the Components of Children's Reading Comprehension Using Rauding Theory

Recent research suggests that as children learn to read they go through several, distinct stages (Adams, 1990; Chall, 1996; Hoover & Gough, 1990; Juel, 1988; Stanovich, 1991; Willson & Rupley, 1993)) or phases (Ehri, 1992; Ehri & Wilce, 1987) ranging from those associated with logos and environmental print to those represented by comprehension and acquisition of new knowledge. Research on these stages and phases has resulted in several models and evolutionary descriptions of reading acquisition, and although these are not in complete agreement, they do share many similarities. For example, Chall's stages of reading development (1996) advance from stage 0 through stage 5. Stage 0, the prereading stage, coincides with the selective association and logographic or visual cue reading phases identified by Ehri (1992). Both of these conceptualizations of emerging reading represent the reader as one who knows little about the letter sound system and who relies heavily on the context of print within the environment to recognize words (Adams, 1990; Ehri, 1991; Gough & Hillinger, 1980).

Movement from dependence on contextualized print to attention to interacting with traditional orthography occurs when readers begin to recognize the shapes, names, and sounds of letters and acquire a low level of phonemic awareness. This capability is characterized by the reader detecting the separate sounds in the pronunciation of words and also in letter names (Chall, 1983; Ehri &: Wilce, 1987; Mason, 1984). Conceptualizing and reasoning about the relationship between graphemic-phonemic

relationships of language represents children's advancement toward reading acquisition and word recognition that facilitates and contributes significantly to comprehension and learning from text. Biemiller (1970) described these readers as those who are beginning to exhibit a continued concern with graphic exactness. Ehri (1992), Juel (1991), and Mason (1980) referred to this increasing attention to text as the cipher stage, which is achieved when readers use their phonetic segmentation and phonological recoding skills to form complete connections that secure the entire spelling of the word in memory as a visual symbol for phonemic units in its pronunciation (Ehri, 1992; Gough, Juel, & Griffith, 1992). Common to readers at this developmental level is the ability to process words by setting up connections between letters and sequences of letters stored in memory with phonemic constituents in the word's pronunciation.

A large body of research indicates that in order for children to become successful in word recognition, they must successfully pass through these early stages or phases of reading. Successful progression enables readers to acquire the ability to gain word recognition automaticity, which is major factor contributing to comprehension at the elementary grade levels (Carver, 1995; Stanovich, 1991; Willson & Rupley, 1993). Decoding and word recognition have clearly been established by researchers (Adams, 1990; Gough & Hillinger, 1980; Juel, 1991; Stanovich, 1992) as important determinants of comprehension of narrative text for beginning readers. This relationship of decoding to comprehension begins to show decreased effect with increased age; however, studies have

shown that word recognition remains a significant predictor for readers at age twelve and above (Rupley & Willson, 1991; Stanovich, 1991).

Although word recognition capabilities contribute significantly to young reader's comprehension, there are other credible variables that have been investigated to better understand what facilitates comprehension of text. For example, background or prior knowledge has become a fundamental assumption about reading comprehension through various theories, including schema theory (e.g., Anderson, Reynolds, Schallert, & Goetz, 1977) and strategy-domain interactive theory (e.g., Alexander & Judy, 1988). Examples of other variables associated with reading comprehension are prediction and text type. However, some individuals (Danneman, 1991; Hoover and Gough, 1990) have argued for a simple view of reading, which includes only the components of decoding and comprehension. In this simple view, decoding is the ability to recognize and match the printed word with its mental lexicon and derive meaning at the word level and reading comprehension is equated with linguistic comprehension, which is mediated through graphically represented information.

Carver (1993) has maintained that the simple view of reading is too simple because it does not account for two salient features of reading and reading ability, reading efficiency and reading rate, and he has developed a theory of reading that incorporates word recognition and comprehension he called rauding theory (Carver, 1991, 1993, 1995). The focus of rauding theory is on ". . . . general reading ability, which can be measured by traditional standardized reading comprehension tests because they are affected by both accuracy level and rate level" (1993, p. 453). Carver (1992) discounted

the roles of prior knowledge, prediction, and text type and maintains that these are trivial factors and can be disregarded when reading narrative text. In recent research, Carver (1993, 1995) affirmed that the simple view of reading, decoding and comprehension, can be merged with rauding theory to provide a theoretical representation of reading that is applicable for beginning through adult readers. Rauding efficiency level (E_L), which is the ability to comprehend efficiently while reading at an equivalent difficulty level is theorized to be affected by two factors, rauding accuracy level (A_L), which is the reading level or the level of ability to accurately comprehend while reading, and rauding rate level (R_L),which is the typical rate of reading usually associated with recreational reading text or simple words. Causally prior components of rauding theory include cognitive power (C_P), which is an intelligence factor reflective of working-memory capacity that exerts an influence on yearly gains in rauding accuracy; cognitive speed (C_S), which is similar to naming speed and is the primary factor influencing reading rate level (R_L), and auditory accuracy level (AUD_L), a representation of listening comprehension. Carver added pronunciation level (P_L) in his (1993) version of the model, which can be viewed as word recognition or the ability to utilize graphemic phonemic relationships in the pronunciation of words. Carver postulated PL that it affects both A_L and R_L and is not directly influenced by either C_P or $AudA_L$, thus an exogenous component of the reading process.

Carver's rauding theory has several components that are supportive of our past research efforts focusing on specifications of the factors associated with elementary-age children's reading comprehension. We have found that word recognition accounts for a

significant portion of the variance associated with elementary students' reading comprehension (R^2 values ranging from 0.90 for grades one and two to 0.55 for grades five and six) (Rupley & Willson, in press). However, we had not considered the rate variables for either word recognition or comprehension. Furthermore, we had not included the variables of cognitive power and cognitive speed in our previous investigations of factors contributing to children's' reading comprehension. Using Carver's construct for reading suggests that measures associated with rate, cognition, and accuracy would account for most of the variance in children's reading comprehension of narrative text.

The purpose of the present study was to theoretically model an adapted representation of rauding theory built on an assimilation of our previous research findings and those of Carver's research. Specifically, we were interested in applying features of rauding theory in exploring the developmental components contributing to elementary-age children's reading comprehension. In addition, we wanted to compare our adapted model of rauding theory to the relationships obtained for each data set across grade levels one through six to provide confirmatory evidence for Carver's rauding theory.

Two changes and one omission were made to Carver's original model. We assumed that C_P and $AudA_L$ should directly affect P_L based on the research cited above relating IQ to word recognition and reading comprehension. While we would predict that the path from C_S to A_L would disappear with this change, we left the C_S-A_L path in because Carver has proposed this as a primary mechanism (Carver, 1993; p. 452). The omission was the lack of a suitable measure of C_S, cognitive speed. Since its only

theoretical influence is on R_L and Carver has not included it in his diagnostic package (Carver, 1993), we felt this was not a critical part of testing his model.

The adapted Carver model is shown in Figure 1. This model is identical to that presented by him (1995) except for the two added paths.

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insert Fig. 1 here

We deliberately did not construct measures identical to those employed by Carver. A major purpose of our investigation was to determine if Carver's model was robust with respect to the constructs he proposed. That is, Carver's model is of little use if the only application is with the specific variables measured exactly as he originally defined them. A general theory should reasonably fit different operationalizations of the same constructs, and the departures in model fit may give indications of the limitations of the model application. Since reading researchers employ a great number of different measures all called reading comprehension, word identification, and the like, Carver's model should be general enough to account for the various findings established for them, even though he has argued that rauding is an extension of theories such as Simple View and does not fit into them. We believed that we had sufficient data and variables to model rauding theory. If the model were supported by our representation, it would provide evidence for robustness of Carver's model. If it were not supported the conclusion would be

problematic because the result might be attributable to inappropriate operationalization rather than inappropriate modeling.

One difficulty we encountered in attempting to model rauding theory was that we did not have adequate variables in a single data set to represent all constructs but that all were available in two different data sets that had identical variables for parts of the model. It was not coincidental that the exogenous and intermediate variables were available in an individual intelligence test data set and the intermediate and dependent endogenous variables were available in a school achievement test battery data set. Thus, the model was evaluated with two separate analyses that estimated the contributions of the variables to their respective parts, with the availability of overlap in evaluation of the relationships among C_P, P_L, and A_L, thus providing internal evidence of model consistency based on two independent samples.

METHOD

Subjects

The standardization samples for the Kaufman Assessment Battery for Children (KABC) (Kaufman & Kaufman, 1983) and the Kaufman Test of Educational Achievement (KTEA) (Kaufman & Kaufman, 1985) were used as the data sources for this study. There were 1085 students: for the KABC, 541 students in grades 1-2 (181), grades 3-4 (176) and grades 5-6 (184); while for the KTEA there were 544 students with 183 students in grades 1-2, 177 subjects in grades 3-4, and 184 subjects in grades 5-6. These elementary students were selected to reasonably mirror the 1980 census.

Instrumentation

The Kaufman Assessment Battery for Children (KABC) provided variables used to operationalize $AudA_L$, C_P, P_L, and A_L. $AudA_L$ was defined by the Riddles subtest of the KTEA. Reynolds (personal communication, October 3, 1996) indicated that this subtest most closely assessed listening ability. The student is asked to name a concrete or abstract concept when given a series of characteristics orally. Thirty-two items are used, and split half reliabilities for the ages studied were all over .85.

C_P was defined by the total IQ score, termed Mental Processing Score, on the KABC. Carver has suggested that C_P is a fluid intelligence construct such as measured by the Raven Progressive Matrices Test. We suggest that a more global intelligence test should functionally define C_P as well. This score is based on 8 subtests individually administered; it functions much as other major individual IQ tests with comparable reliability and validity, with split half reliabilities over .95 for the ages studied.

Pronunciation level (P_L)is virtually identical with most word identification tests. In the KABC an achievement test called Reading Decoding presents words to the student to pronounce. Words were selected from over 10,000 samples of texts at grade levels 3 to 9. Word frequency and linguistic features were used to select 38 words used in the test. Split half reliabilities were all over .90 for all ages investigated.

Reading comprehension (A_L) was assessed from the KABC using the subtest Reading Understanding. In this subtest children are presented on an easel a series of tasks or commands that they must read and then perform. This format is quite different from the typical reading comprehension test and minimizes prior knowledge and verbal fluency.

Since children read at their own rate and this test has only easy words it reasonably fits Carver's rauding accuracy level. Split half reliabilities were all over .90 for the ages studied.

The Kaufman Test of Educational Achievement (KTEA) was used as the second data source for this investigation. Identically developed subtests, Reading Decoding and Reading Understanding (comprehension), were available (Reading Decoding split-half reliability greater than .95, Reading Comprehension split-half reliability greater than .90 for each age grouping used). The KTEA is individually administered and provides norms from the ages of six to eighteen years eleven months. In addition, the testing time for each subject on each subtest was available. This allowed us to construct measures similar to Carver's Rauding rate level R_L and Rauding efficiency level E_L by dividing the number of items correct on each subtest by the time of testing. While these measures are clearly not identical to Carver's (1993) formulation, they do represent rate measures of decoding simple words (RL is the rate of comprehending simple text) and reading efficiency (the most difficult material that is comprehended at a rate comparable to the material). We considered alternative formulations (e.g., using our E_L measure as a rauding rate level); however, the intent of E_L seems to be better framed as a working definition of efficiency, that is, how well comprehension occurs per unit time. Because the Reading comprehension test assesses maximum difficulty of comprehension of actual text rather than words, it theoretically better represents the component of rauding efficiency.

The Reading comprehension subtest uses paragraphs of varying lengths to sample comprehension. Students respond orally to literal and inferential questions that are asked

following the reading of each passage. Students are allowed to respond orally or gesturally depending on the difficulty of the passage.

For the KTEA analysis, to assess cognitive power (C_P) we used the Peabody Picture Vocabulary Test-Revised (PPVT-R). The PPVT-R is an individually administered power test of listening vocabulary. It has a median correlation of .62 with the Stanford-Binet Intelligence Scale, .58 with the KABC Mental Processing Score, and a median correlation .64 with Wechsler Intelligence Scale for Children. The PPVT-R is administered individually and the student selects one of four pictures that best represent the meaning of the stimulus word. It has a split-half reliability median of .81 for school age children and delayed retest alternate-forms reliability coefficient median of .77. Based upon our previous research and our theoretical modeling of rauding theory research findings we considered the PPVT-R to be a valid measure of cognitive power, particularly for verbal, crystallized components of intelligence. Since both the more global KABC Mental Processing Score and the PPVT-R score were available for investigating the same relationships, it allowed us to compare their relative utility for Rauding theory. Carver (1993) suggested that fluid intelligence as represented by the Raven Progressive Matrices Test most directly corresponds to cognitive power (C_P). Both measures used here have greater verbal, crystallized intelligence components than the Raven. A direct comparison using the KABC Simultaneous Processing Score was available, but preliminary analyses indicated virtually no difference in the models investigated. This point will be discussed in the conclusions.

Analyses

The methodology chosen for this study is based on structural equation modeling (SEM), also termed LISREL. This methodology represents the most technologically advanced quantitative approach yet developed, including measurement theory, factor analysis, path modeling of underlying factors and linear modeling of relationships. All analyses employed here were manifest variable path models, since the factor structures of the subtests were assumed to follow those represented in the technical manuals of the KABC and KTEA. Based on the model presented in Figure 1 we examined the path models for grades one-two, three-four, and five-six to explore the application of the constructs of rauding theory to each of these grade levels and to determine the fit of each model to our theoretical model. It should be noted that a covariance of zero was assumed between C_P and $AudA_L$, consistent with Carver (1993). A liberal alpha level was applied to testing hypothesized paths (.05) while a stringent criterion ($p<.001$) was applied to add a new path using Lagrange Multiplier tests (Bollen, 1989). Two goodness of fit indices were examined, the adjusted goodness-of-fit index (AGFI) and Normed Fit Index (NFI, Bentler & Bonett, 1980) based on Tanaka's (1993) discussion of criteria for use and various studies of their robustness across various model assumptions. In general the subtests met well the multivariate normality assumption underlying SEM analysis.

RESULTS

A great deal of statistical output is typically available from the program used, PROC CALIS (SAS Institute Inc., 1989), so only relevant aspects will be discussed. Since measures are comparable across the two analyses performed at each pair of grades,

covariances are shown in the Figures accompanying the analyses. Significance levels are all beyond $p<.05$ for hypothesized paths and beyond .001 for added paths. In cases where the path is not significant they are indicated by 'ns' following the coefficient value.

Since all data are the normative samples for the national testing, means and standard deviations are unimportant except to note that they are the reported means for the tests (mean 50, SD 10) except for the Mental Processing Score (mean 90, SD 13) which was adjusted for $AudA_L$. For Grades 1-2 the rate measures are R_L (mean 4.73, SD 3.94) and E_L (mean .163, SD .185);for Grades 3-4 they are R_L (mean 7.77, SD 5.09) and E_L (mean .326, SD .199); for Grades 5-6 they are R_L (mean 9.01, SD 5.17) and E_L (mean .375, SD .190).

Grades one and two

The two analyses are shown in Fig. 2 below, with KABC path coefficients first, KTEA coefficients second, for the overlapping analyses. The theoretical model based on rauding theory had AGFI's over .90 and NFI's over .96. One path was indicated to be added, from P_L to E_L, with changes of AGFI to .951 and NFI to .992. At these grades the path from C_P to P_L was significant for the KABC Mental Processing measure of C_P while it was not significant for the PPVT-R. The path from C_P to A_L exhibited the inverse: KABC C_P was not significant while PPVTR was. Our hypothesized path from $AudA_L$ to P_L, not in Carver's original formulation, was significant. All other paths hypothesized by Carver were significant. Covariance values were quite similar for overlapping analyses, even though in several cases one coefficient was significant while the other was not for a

given path. The strongest relationships were between $AudA_L$ and P_L and between P_L and A_L.

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insert Fig. 2 about here

Grades three and four

The two analyses are shown in Figure 3 below, with KABC path coefficients first, KTEA coefficients second, for the overlapping analyses. The theoretical model based on rauding theory had AGFI's over .95 and NFI's over .97. No paths were indicated to be added. The path from C_P to A_L showed that for the KABC C_P was not significant while for PPVT-R it was. Our hypothesized path from $AudA_L$ to P_L, not in Carver's original formulation, was significant. Two other paths, A_L to E_L and P_L to R_L, hypothesized by Carver were not significant, while the remainder were. Covariance values were less similar for overlapping analyses than in grades 1-2, and as before in one path (C_P to A_L) one coefficient was significant while the other was not. The strongest relationships were between $AudA_L$ and P_L and between P_L and A_L, with the latter stronger than in grades 1-2.

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insert Fig. 3 about here

Grades five and six

The two analyses are shown in Figure 4 below, with KABC path coefficients first, KTEA coefficients second, for the overlapping analyses. The theoretical model based on

rauding theory had AGFI's over .90 and NFI's over .95. No paths were indicated to be added. Our hypothesized paths from C_P to P_L and $AudA_L$ to P_L, not in Carver's original formulation, were significant for all analyses. The paths A_L to E_L and P_L to R_L hypothesized by Carver were not significant. Covariance values were less similar for C_P to P_L and C_P to A_L than in grades 1-2 and were stronger than in grades 3-4. The PPVT-R C_P measure exhibited a stronger effect of A_L than the KABC measure of C_P. The strongest relationships were between $AudA_L$ and P_L and between P_L and A_L, with the latter weaker than in either grades 1-2 or grades 3-4. Finally, there was support for a path between C_P and E_L at this level, which might substitute for Carver's hypothesized path A_L to E_L, which was nonsignificant. This model was not explored further because there is no current theoretical justification.

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insert Fig. 4 about here

SUMMARY AND CONCLUSIONS

The results of this study for grades one and two maintain and support Carver's (1993, 1995) rauding theory concepts and the research cited earlier that reports the major contribution that word recognition makes to elementary-age children's reading comprehension. The theoretical model we proposed based on the adaptation of rauding theory in light of research on stages and phases of reading development and our own research on factors contributing to young children's reading comprehension had an NFI of

.992. The only difference noticed in the first and second grade analyses was the addition of a path from P_L (word recognition) to E_L (efficiency level) . For young children this indicates that rauding efficiency level is directly related to decoding as well as to rauding accuracy level. Accuracy level thus would be directly influenced by the rate of processing text. Slower rate of decoding would directly affect comprehension in chunking information in memory.

The reading model for grades one and two advanced the credibility of the role that word recognition rate plays in comprehension. The most important direct path to comprehension was from word recognition. Carver (1993) has submitted that measures associated with word recognition (accuracy and rate) would account for most of the reliable variance in primary children's reading comprehension. Our reading model for grades 1-2 supports Carver's proposal. The KABC measure of C_P, which Carver predicted would directly influence reading comprehension (A_L) had only a small contribution, while the PPVT-R was generally large, yet still small until grades 5-6. This is consistent with Stanovich, Cunningham, & Feeman (1984) and Rupley & Willson (in press) that cognitive power (C_P) operates primarily through decoding and does not directly influence reading comprehension in young readers. However, as Carver has suggested, cognitive power is theorized to be a factor influencing yearly gain in students' reading comprehension. Support for his theory was found at grades 3-4 and grades 5-6. A direct path emerged at grades three and four from cognitive power (PPVT-R) to both word recognition and comprehension, and at grades 5-6 both measures of C_P directly affected both decoding and comprehension. The strength of the paths increased from grades three and four to grades

five and six. Concomitant with the increase in cognitive power was a decrease in the association of word recognition with comprehension and no effect for comprehension on comprehension rate. Our finding that neither word recognition rate nor comprehension rate had paths with other grades 3-4 and 5-6 variables results in the failure to advance the credibility of these variables contributing to reading comprehension, although they did covary with each other at all levels. This finding does not however differ from Carver's (1993, 1995) assertion in discussing his Simple View II of reading. His data analyses support the hypotheses that word recognition and listening ability alone have a direct causal effect on improvement in reading comprehension for elementary-age children. Our data would support his hypothesis and advance the credibility that ability to effeciently recognize words coupled with general language capabilities are important contributors to the ability to comprehend text.

Not only do the results of this study offer support to Carver's (1993) Simple View II of reading, but they further advance the conceptualization that children go through stages or phases of reading development as they refine and acquire reading capabilities. Although word recognition remains a salient component throughout the elementary grades, its contribution to comprehension begins to lesson at the higher grade levels, which are indicative of the acquisition of additional reading capabilities. The decreased effects of word recognition on comprehension with increased age and proficiency supports the idea that word recognition becomes more automatic and its relations to reading comprehension becomes less apparent. The slight increase with grade of cognitive power's

(C_p) effect on reading comprehension is greater for crystallized (PPVT-R) intelligence than for global (fluid and crystallized) or fluid intelligence. As was mentioned earlier, preliminary analyses with nonverbal, fluid intelligence (the KABC Simultaneous Processing score) produced virtually identical results.

REFERENCES

Adams, M. J. (1990). Beginning to read. Cambridge: MIT Press.

Alexander, P. A., & Judy, J. E. (1988). The interaction of domain-specific and strategic knowledge in academic performance. Review of Educational Research, 58, 375- 404.

Anderson, R. C., Reynolds, R. E., Schallert, D. L., & Goetz, E. T. (1977). Frameworks for comprehending discourse. American Educational Research JJournal, 14, 367-382.

Biemiller, A. (1970). The development of the use of graphic and contextual information as children learn to read. Reading Research Quarterly, 6, 75-96.

Bollen, K. A. (1989). Structural equations with latent variables. New York: John Wiley and Sons.

Carver, R. P. (1995, April). Causal model for reading achievement. Paper presented at the annual meeting of the Society for the Scientific Study of Reading, New York, NY.

Carver, R. P. (1993). Merging the simple view of reading with rauding theory. Journal of Reading Behavior, 4, 439-454.

Carver. R. P. (1992). Effect of prediction activities, prior knowledge, and text type upon amount comprehended: Using rauding theory to critique schema theory research. Reading Research Quarterly, 27, 165-174.

Carver. R. P. (1985). Measuring absolute amounts of reading comprehension using the rauding rescaling procedures. Journal of Reading Behavior, 18, 29-53.

Chall, J. S. (1996). Stages of reading development. New York: McGraw- Hill.

Daneman, M. (1991). Individual differences in reading skills. In R. Barr, M. Kamil, P. Mosenthal, & P. Pearson, (Eds.), Handbook of reading research (vol. 2, pp. 512-538). White Plains, NY: Longman.

Dunn, L. M., Dunn, L. M. (1981). Peabody Picture Vocabulary Test-Revised: Manual. American Guidance Service, Circle Pines, MN.

Ehri, L. C. (1992) Reconceptualizing the development of sight word reading and its relationship to recoding. In P. Gough, L. Ehri, & R. Treiman (Eds.), Reading acquisition, (pp. 107-144). Hillsdale, NJ: Lawrence Erlbaum Associates.

Ehri, L. C. (1991). Development of the ability to read words. In R. Barr, M. Kamil, P. Mosenthal, & P. Pearson, (Eds.), Handbook of reading research (Vol. 2, pp. 383-417). White Plains, NY: Longman.

Ehri, L. C., & Wilce, L. S. (1987). Cipher versus cue reading: An experiment in decoding acquisition. Journal of Educational Psychology, 79, 3-13.

Gough, P. B., Juel, C., & Griffith, P. L. (1992). Reading, spelling, and the orthographic cipher. In P. Gough, L. Ehri, & R. Treiman (Eds.), Reading acquisition, (pp. 35-48). Hillsdale, NJ: Lawrence Erlbaum Associates.

Gough, P. B., &: Hillinger, M. L. (1980). Learning to read: An unnatural act.

Bulletin of the Orton Society, 30, 179-196.

Hoover, W. A., & Gough, P. B. (1990). The simple view of reading. Reading and Writing, 2, 127-160.

Juel, C. (1991). Beginning reading. In R. Barr, M. Kamil, P. Mosenthal, & P. Pearson, (Eds.), Handbook of reading research (Vol. 2, pp. 759-788). White Plains, NY: Longman.

Kaufman, A. S:, & Kaufman, N. L. (1983). Kaufman assessment battery for children. Circle Pines, MN: American Guidance Services.

Kaufman, A. S., & Kaufman, N. L. (1985). Kaufman test of educational achievement: Comprehensive form manual. Circle Pines, MN: American Guidance Services.

Mason, J. M. (1984). Early reading from a developmental perspective. In R. Barr, M. Kamil, P. Mosenthal, & P. Pearson, (Eds.), Handbook of reading research (pp. 505-504). White Plains, NY: Longman.

Mason, J. M. (1980). When do children begin to read: An exploration of four year old children's letter and word reading comprehension. Reading Research Quarterly, 25, 203-224.

Rupley, W. H., & Willson, V. L. (in press).

SAS Institute Inc. (1989). SAT/STAT User's Guide, version 6, (Fourth Ed.). Cary, NC: SAS Institute Inc.

Stanovich, K. E. (1992). Speculations on the causes and consequences of

individual differences in early reading acquisition. In P. Gough, L. Ehri, & A.Treiman (Eds.), Reading acquisition, (pp. 307-342). Hillsdale, NJ: Lawrence Erlbaum Associates.

Stanovich, K. E. (1991). Word recognition: Changing perspectives. In R. Barr, M. Kamil, P. Mosenthal, & P. Pearson, (Eds.), Handbook of reading Research (vol. 2, pp. 418-452). White Plains, NY: Longman.

Stanovich, K. E. (1990). Concepts in developmental theories of reading skill: Cognitive resources, automaticity, and modularity. Developmental Review, 10, 72-100.

Tanaka, J. S. (1993). Multifaceted conceptions of fit in structural equation models. In K. A. Bollen & J. S. Long (Eds.), Testing structural equation models. Newbury Park, CA: Sage Publications, Inc.

Willson, V. L., & Rupley, W. H. (1993). Structural components of single word recognition: Activation of orthographic, meaning, and phonological processors. Reading Research and Instruction, 32, 33-45.

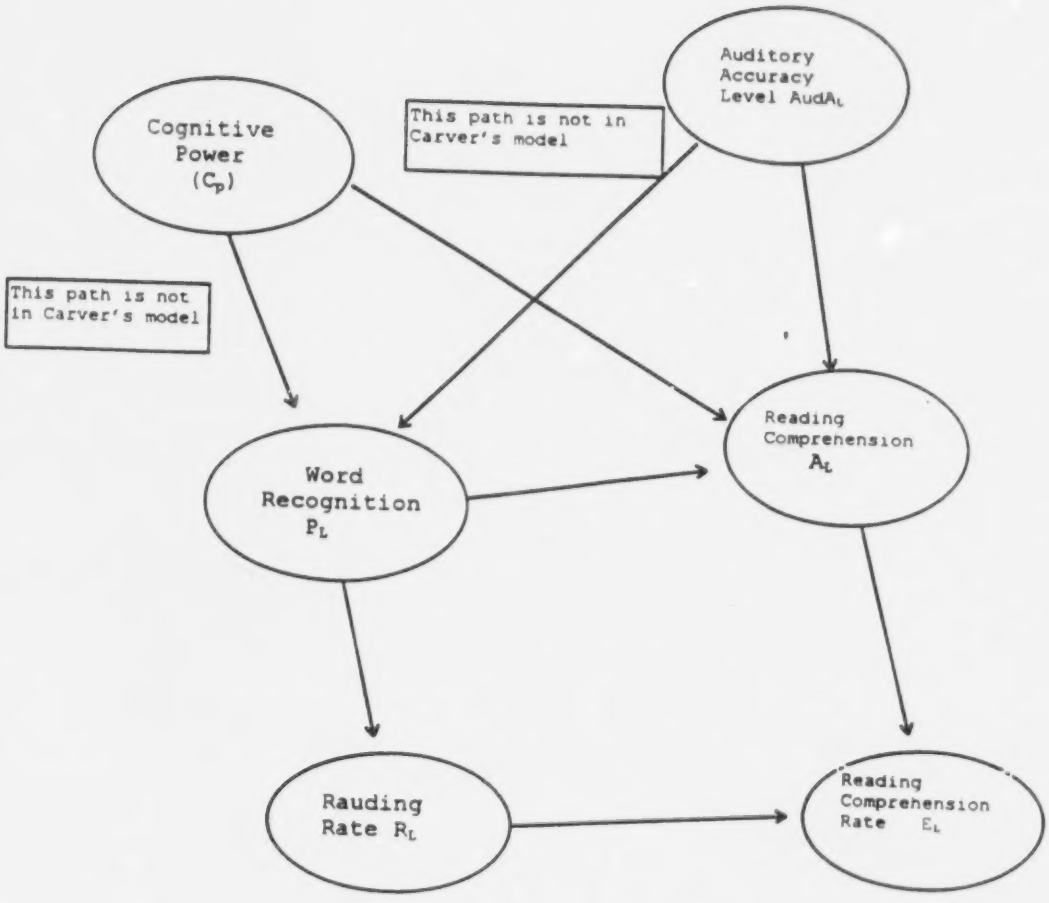
Figure Captions

Figure 1: Modified Theoretical Rauding Model in Structural Form

Figure 2: Grades 1-2 SEM Analyses of Rauding Model

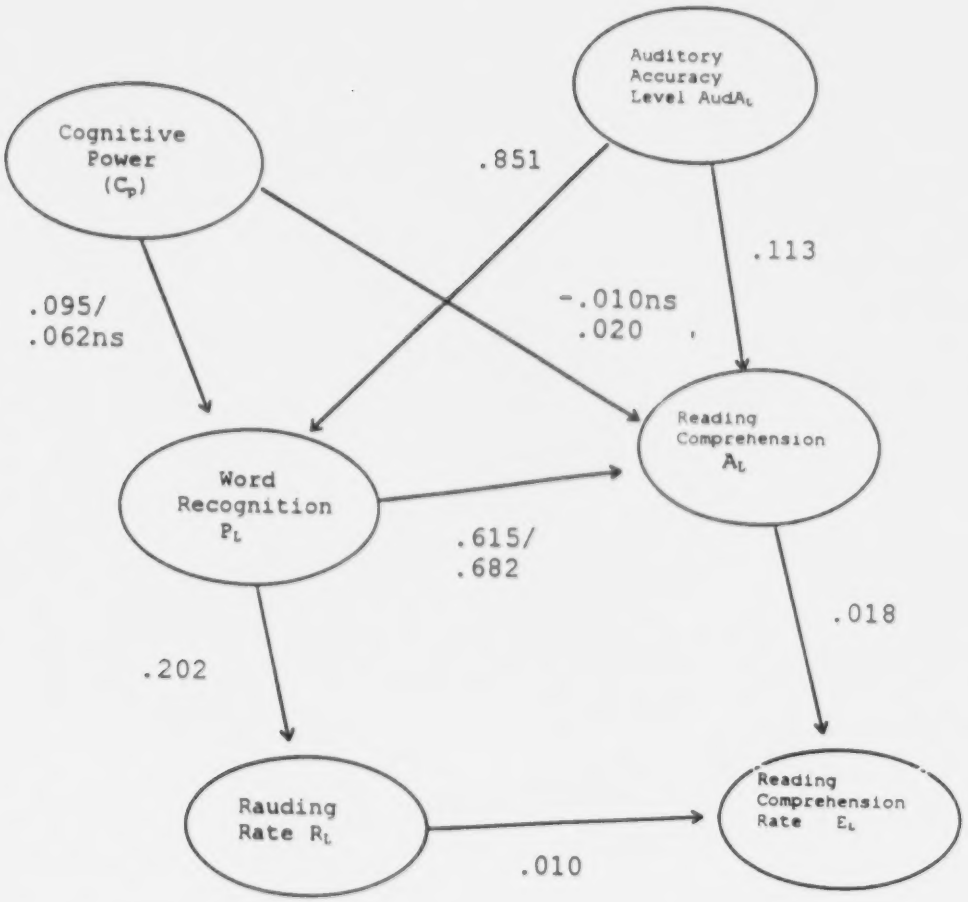
Figure 3: Grades 3-4 SEM Analyses of Rauding Model

Figure 2: Grades 5-6 SEM Analyses of Rauding Model

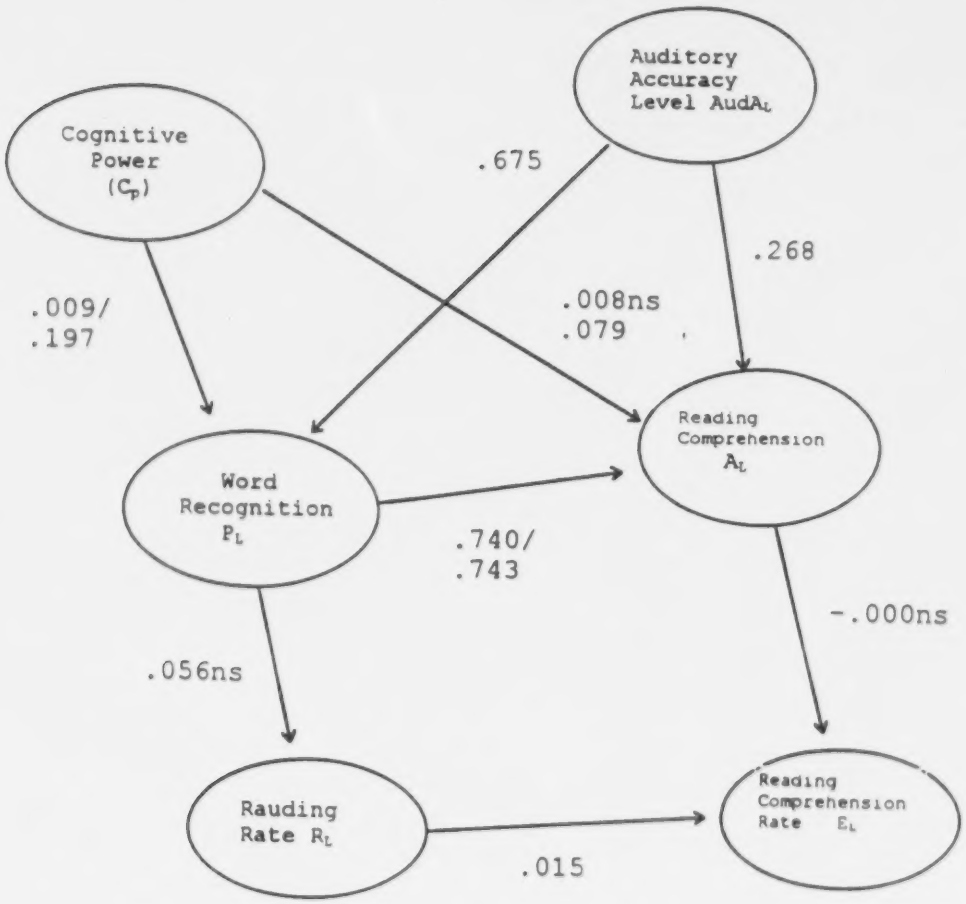

Auditory Accuracy Level $AudA_L$
Cognitive Power (C_p)
This path is not in Carver's model
This path is not in Carver's model
Reading Comprehension A_L
Word Recognition P_L
Rauding Rate R_L
Reading Comprehension Rate E_L

BEST COPY AVAILABLE

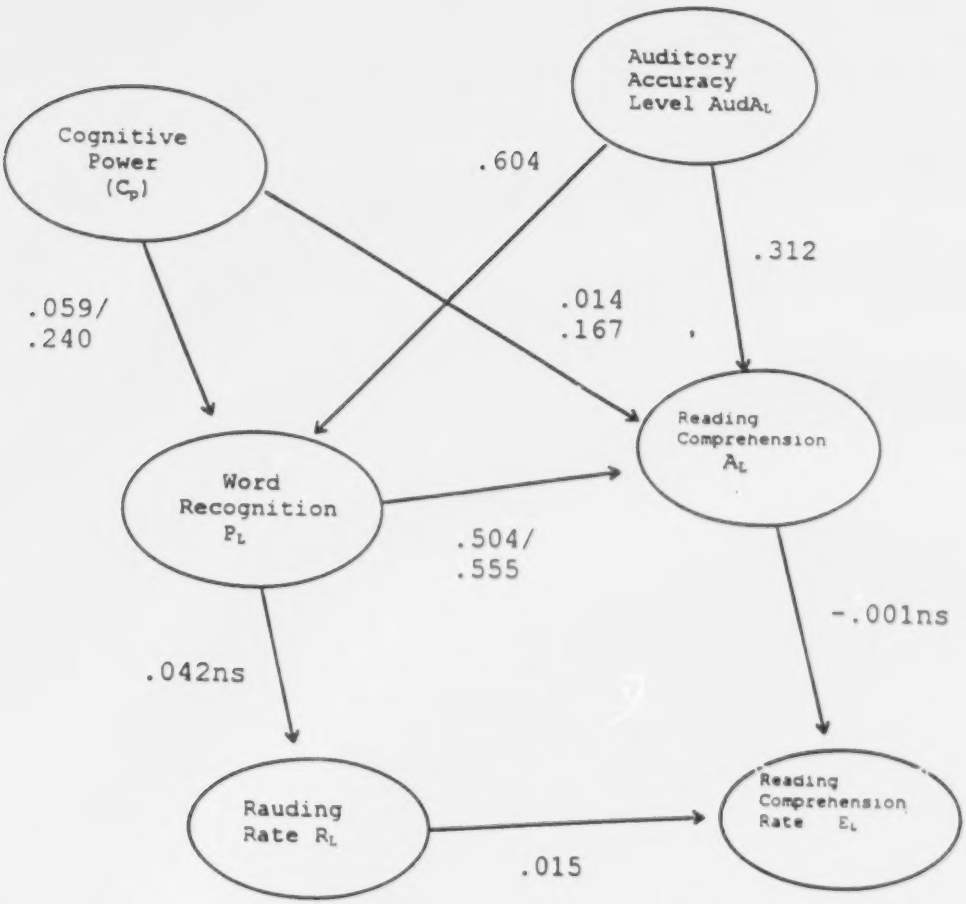
GRADES 1-2


Auditory Accuracy Level $AudA_L$
Cognitive Power (C_p)
.851
.113
.095/ .062ns
-.010ns .020
Reading Comprehension A_L
Word Recognition P_L
.615/ .682
.018
.202
Rauding Rate R_L
Reading Comprehension Rate E_L
.010

GRADES 3-4


Auditory Accuracy Level AudA$_L$
Cognitive Power (C_p)
.675
.268
.009/ .197
.008ns .079
Reading Comprehension A_L
Word Recognition P_L
.740/ .743
-.000ns
.056ns
Rauding Rate R_L
Reading Comprehension Rate E_L
.015

GRADES 5-6


Auditory Accuracy Level AudA$_L$
Cognitive Power (C_p)
.604
.312
.059/ .240
.014 .167
Reading Comprehension A_L
Word Recognition P_L
.504/ .555
-.001ns
.042ns
Rauding Rate R_L
Reading Comprehension Rate E_L
.015